NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

Streambank and Shoreline Protection
(FT)
No. 580

Definition

Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

Purpose

- To prevent the loss of land or damage to land uses, or other facilities adjacent to the banks, including the protection of known historical, archeological, and traditional cultural properties.
- To maintain the flow or storage capacity of the water body or to reduce the offsite or downstream effects of sediment resulting from bank erosion.
- To improve or enhance the stream corridor for fish and wildlife habitat, aesthetics, and recreation.

Conditions Where Practice Applies

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. It applies to controlling erosion where the problem can be solved with relatively simple structural measures, vegetation, or upland erosion control practices. It does not apply to erosion problems on main oceanfronts and similar areas of complexity not normally within the scope of NRCS authority or expertise.

Federal, State, and Local Laws[1]

Design and construction activities shall comply with all federal, state, and local laws, rules, and regulations governing pollution abatement, health, and safety. The owner or operator shall be responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations. NRCS employees are not to assume responsibility for procuring these permits, rights, or approvals, or for enforcing laws and regulations. NRCS may provide the landowner or operator with technical information needed to obtain the required rights or approvals to construct, operate, and maintain the practice.

Permits may be required from the following agencies:

1. ***West Virginia Department of Health***
2. ***West Virginia Department of Agriculture***
3. ***U.S. Army Corps of Engineers***

Planning Considerations

Water Quantity

1. Effects on the water budget, especially on volumes and rates of runoff, infiltration, deep percolation, and ground water recharge.
2. Effects on downstream flows and aquifers that affect other uses and users.
3. Effects on the water table of adjoining fields.
4. Effects on the interflow discharge into streams.

Water Quality

1. Filtering effects of vegetation on movement of sediment, and sediment-attached, and dissolved substances.

2. Effects on erosion and movement of sediment, and soluble and sediment-attached substances carried by runoff and streamflow.

3. Effects on the visual quality of on-site and downstream water resources.

4. Effects of construction and vegetation establishment on quality.

5. Effects of changes in water temperatures.

6. Short-term and long-term effects on wetlands and water-related wildlife habitats.

Design Criteria

General Criteria Applicable to All Purposes

Measures must be installed according to a site-specific plan and in accordance with all applicable local, state, and federal laws and regulations.

Protective measures to be applied shall be compatible with improvements planned or being carried out by others.

Protective measures shall be compatible with the bank or shoreline materials, water chemistry, channel or lake hydraulics, and slope characteristics both above and below the water line.

End sections shall be adequately bonded to existing measures, terminate in stable areas, or be otherwise stabilized.

Protective measures shall be installed on stable slopes. Bank or shoreline materials and type of measure installed shall determine maximum slopes.

Designs will provide for protection from upslope runoff.

Internal drainage for bank seepage shall be provided when needed. Geotextiles or properly designed filter bedding shall be used on structural measures where there is the potential for migration of material from behind the measure.

Measures applied shall not adversely affect threatened and endangered species nor species of special concern as defined by the appropriate state and federal agencies.

Measures shall be designed for anticipated ice action and fluctuating water levels.

All disturbed areas around protective measures shall be protected from erosion. Disturbed areas that are not to be cultivated shall be protected as soon as practical after construction. Vegetation shall be selected that is best suited for the soil/moisture regime.

Vegetative measures shall conform to requirements contained in WV Standard 342, Critical Area Planting. Side slopes will be no steeper than those shown below.

Material	***Side Slope***
Sand or silt with clay binder	***2:1***
Heavy clay or silty clay	***1 1/2:1***
Gravel, clean	***2:1***
Sand, clean	***1:1***
Solid rock	***1/4:1***
Loose rock or cemented gravel (cut)	***1:1***

Where possible, streambank and shoreline protection measures will be designed such that construction activities can be performed from the bank. Erosion and sediment control measures such as diking, mulching, temporary seeding, etc. will be incorporated in the design.

Additional Criteria for Streambanks

The channel grade shall be stable based on a field assessment before any permanent type of bank protection can be considered feasible, unless the protection can be constructed to a depth below the anticipated lowest depth of streambed scour.

A protective toe shall be provided based on an evaluation of stream bed and bank stability.

Channel clearing to remove stumps, fallen trees, debris, and bars shall only be done when they are causing or could cause detrimental bank erosion or structural failure. Habitat forming elements that provide cover, food, and pools, and water turbulence shall be retained or replaced to the extent possible.

Changes in channel alignment shall not be made unless the changes are based on an evaluation that includes an assessment of both upstream and downstream fluvial geomorphology. The current and future discharge-sediment regime shall be based on an assessment of the watershed above the proposed channel alignment.

Measures shall be functional for the design flow and sustainable for higher flow conditions based on acceptable risk.

Measures shall be designed to avoid an increase in natural erosion downstream.

Measures planned shall not limit stream flow access to the floodplain.

Stream segments to be protected shall be classified according to a system deemed appropriate by the state. Segments that are incised or contain the 5-year return period (20 percent probability) or greater flows shall be evaluated for further degradation or aggradation.

When water surface elevations are a concern, the effects of protective measures shall not increase flow levels above those that exist prior to installation.

Streambank protection measures will be designed to withstand the velocities and forces to which they are subjected. They will be designed according to procedures contained in Technical Release 25 or Highway Research Report 108 (Tentative Design Procedures for Riprap-lined Channels). Procedures contained in Bank and Shore Protection in California Highway Practice, may also be used.

On uniform streams with drainage areas of 640 ac. or less and stream velocities of 12 fps or less, procedures contained in Chapter 16 of the Engineering Field Handbook may be used. Stream velocities can be determined using Manning's Equation with appropriate values of "n".

Manning's roughness coefficient "n" will be estimated using procedures contained in Supplement B of NEH-5, Hydraulics, or for conservative answers, on watersheds with drainage areas less than 640 ac., a value of 0.025 to 0.030 may be used.

Channel flow restrictions such as narrow cross sections, rock ledges, culverts, bridges, etc., will necessitate a detail water surface profile determination for realistic capacity computations. All channels which have restrictions mentioned above, regardless of drainage area size, shall have detail water surface profile calculations. The consideration of changes in velocity head between sections may be disregarded when they are insignificant.

Structural measures will be designed to extend to the elevation of peak flow from a 5 yr.-24 hr storm or bank-full flow, whichever is the least. However, if structural measures do not extend to the top of the bank, they will be stable at bank-full flows.

Toe scour will be controlled by either natural or artificial means or the bank protection will be constructed to a depth below the anticipated lowest depth of bottom scour. The minimum depth of scour protection below the stream bottom will be 1.0 ft. for streambank protection measures less than 4 ft. high and 2.0 ft. for those measures greater than 4.0 ft. high.

Ends of revetments, bulkheads, jetties and groins shall be keyed into the bank a minimum depth equal to the height of the bank protection.

Control of surface runoff and internal drainage shall be considered in all designs.

Channel alignment changes will meet the requirements of WV Engineering Standard 582, Open Channel.

For uniform streams with drainage areas of 640 ac. or less, the allowable permissible

velocities shall be as established in Table 9-1 of the Engineering Field Handbook.

Additional Criteria for Shorelines

All revetments, bulkheads, or groins are to be no higher than 3 feet (1 meter) above mean high tide, or mean high water in non-tidal areas.

Structural shoreline protective measures shall be keyed to a depth to prevent scour during low water.

For the design of structural measures, the site characteristics below the waterline shall be evaluated for a minimum of 50 ft (15 meters) horizontal distance from the shoreline measured at the design water surface.

The height of the protection shall be based on the design water surface plus the computed wave height and freeboard. The design water surface in tidal areas shall be mean high tide.

When vegetation is selected as the protective treatment, a temporary breakwater shall be used during establishment when wave run up would damage the vegetation.

Shoreline protection measures will be designed according to procedures contained in Technical Release 56 and Technical Release 69. Procedures contained in Bank and Shore Protection in California Highway Practice, may also be used.

The measures shall be designed to extend from a minimum of 2.0 ft. below the water surface to the elevation of the anticipated maximum wave height.

Additional Criteria for Stream Corridor Improvement

Stream corridor vegetative components shall be established as necessary for ecosystem functioning and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in re-established stream corridors.

Measures shall be designed to achieve any habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Objectives are based on the survival and reproductive needs of populations and communities, which include habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors and native plant communities. The type, amount, and distribution of vegetation shall be based on the requirements of the fish and wildlife species or communities of concern to the extent possible.

Measures shall be designed to meet any aesthetic objectives as determined by a site-specific assessment or management plan. Aesthetic objectives are based on human needs, including visual quality, noise control, and microclimate control. Construction materials, grading practices, and other site development elements shall be selected and designed to be compatible with adjacent land uses.

Measures shall be designed to achieve any recreation objectives as determined by a site-specific assessment or management plan. Recreation objectives are based on type of human use and safety requirements.

Provisions contained in WV Standards 645, Wildlife Upland Habitat Management; and 644, Wildlife Wetland Habitat Management shall be incorporated where possible and necessary.

Considerations

An assessment of streambank or shoreline protection needs should be made in sufficient detail to identify the causes contributing to the instability (e.g. watershed alterations resulting in significant modifications of discharge or sediment production). Due to the complexity of such an assessment an interdisciplinary team should be utilized.

When designing protective measures, consider the changes that may occur in the watershed hydrology and sedimentation over the design life of the measure.

Consider utilizing debris removed from the channel or streambank into the treatment design.

Use construction materials, grading practices, vegetation, and other site development elements

that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Utilize vegetative species that are native and/or compatible with local ecosystems. Avoid introduced or exotic species that could become nuisances. Consider species that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Species diversity should be considered to avoid loss of function due to species-specific pests. Species on noxious plant lists should not be used.

Livestock exclusion should be considered during establishment of vegetative measures and appropriate grazing practices applied after establishment to maintain plant community integrity. Wildlife may also need to be controlled during establishment of vegetative measures. Temporary and local population control methods should be used with caution and within state and local regulations.

Measures that promote beneficial sediment deposition and the filtering of sediment, sediment-attached, and dissolved substances should be considered.

Consider maintaining or improving the habitat value for fish and wildlife, including lowering or moderating water temperature, and improving water quality.

Consideration should be given to protecting side channel inlets and outlets from erosion.

Toe rock should be large enough to provide a stable base and graded to provide aquatic habitat.

Consider maximizing adjacent wetland functions and values with the project design and minimize adverse effects to existing wetland functions and values.

When appropriate, establish a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed measures, improve their function, filter out sediments, nutrients, and pollutants from runoff, and provide additional wildlife habitat.

Consider conservation and stabilization of archeological, historic, structural and traditional cultural properties when applicable.

Measures should be designed to minimize safety hazards to boaters, swimmers, or people using the shoreline or streambank.

Protective measures should be self-sustaining or require minimum maintenance.

Plans and Specifications

Plans and specifications for streambank and shoreline protection shall be prepared for specific field sites and based on this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

NEH-20 specifications, WV "700 Series" specifications and specifications attached to individual WV practice standards will be used as appropriate.

Drawings and specifications shall show as a minimum:

1. ***Practice layout data, including TBM, end locations, locations of spoil areas, and other structural details.***
2. ***Dimensions of structural measures.***
3. ***Applicable ASTM or other reference specifications for materials to be incorporated in the practice.***
4. ***Application rates and methods for establishing vegetation.***
5. ***Gradations, quality, and construction details of riprap and gravel, if used.***
6. ***Dimensions, details and specifications for associated practices such as fencing, temporary seeding, etc.***
7. ***Provisions for disposal of woody material from clearing operations, excess excavated material, and other debris. Disposal methods and areas will be such***

that the material will be stable and cannot reenter the stream.

Operation and Maintenance

An operation and maintenance plan shall be prepared for use by the owner or others responsible for operating and maintaining the system. The plan shall provide specific instructions for operating and maintaining the system to insure that it functions properly. It shall also provide for periodic inspections and prompt repair or replacement of damaged components or erosion.

An operation and maintenance plan shall be prepared for streambank or shoreline protection measures. The plan shall include, as a minimum, the following items:

1. ***Provisions for annual inspections and inspections following every major storm event.***
2. ***Repair, replacement or addition of structural or vegetative measures, where needed because of damaging high flows.***
3. ***Removal of sediment bars, undesirable vegetative growth, or other stream obstructions that may be causing flow to be diverted into the protection measures.***

[1]Bold italics is information added to the National standard by West Virginia.